

Gear Metrology and Performance Prediction

Status: Transitioned

PROBLEM / OBJECTIVE

Manufacturing errors in meshing gears were causing vibrations in a sensitive military application. Errors were of such a magnitude as to be unmeasurable using conventional methods.

The objective was to solve the problem using an in-situ measurement system, allowing for repair in place. First, the necessary accuracy was determined analytically, then the measurement system was invented (achieving accuracies 40X better than existing systems), and then a method to provide feedback to the repair efforts was derived.



ACCOMPLISHMENTS / PAYOFF

Process Improvement:

The contribution of manufacturing errors to vibrations was identified, allowing gear manufacturers to specify gear accuracy requirements to reduce the vibrations associated with meshing gears. A measurement procedure was invented that provided the necessary measurement accuracy to provide real-time feedback during the manufacturing process.

Implementation and Technology Transfer:

The U. S. Navy implemented this technology on an operating ship for \$4M. The technology has been transferred to the OEM for follow-on units.

Expected Benefits:

The cost avoidance to investment ratio was 39:1, with a net present value of \$26M. This was based on cost avoidance on the first ship of \$2M and \$6M per unit for follow-on ships. Relevance of this technology to other applications is being investigated.

Performance Recognition:

The U.S. Navy specifically cited the project leader. Dr. William D. Mark of ARL Penn State was awarded the Navy Meritorious Civilian Service Medal for his unique and outstanding performance while serving as lead analyst and designer for the measurement process, leading to the mechanical modification incorporated *in situ* aboard an operational ship.

TIME LINE / MILESTONE

Start Date: January 1994

End Date: July 2000

FUNDING

Navy ManTech: \$0.671M

Cost Sharing:

Program Office: \$4M

PARTICIPANTS

Penn State Applied Research Laboratory (iMAST)

Drivetrain Technology Center, ARL Penn State

Naval Sea Systems Command

General Dynamics

Northrop Grumman